EMU Low Voltage Plans

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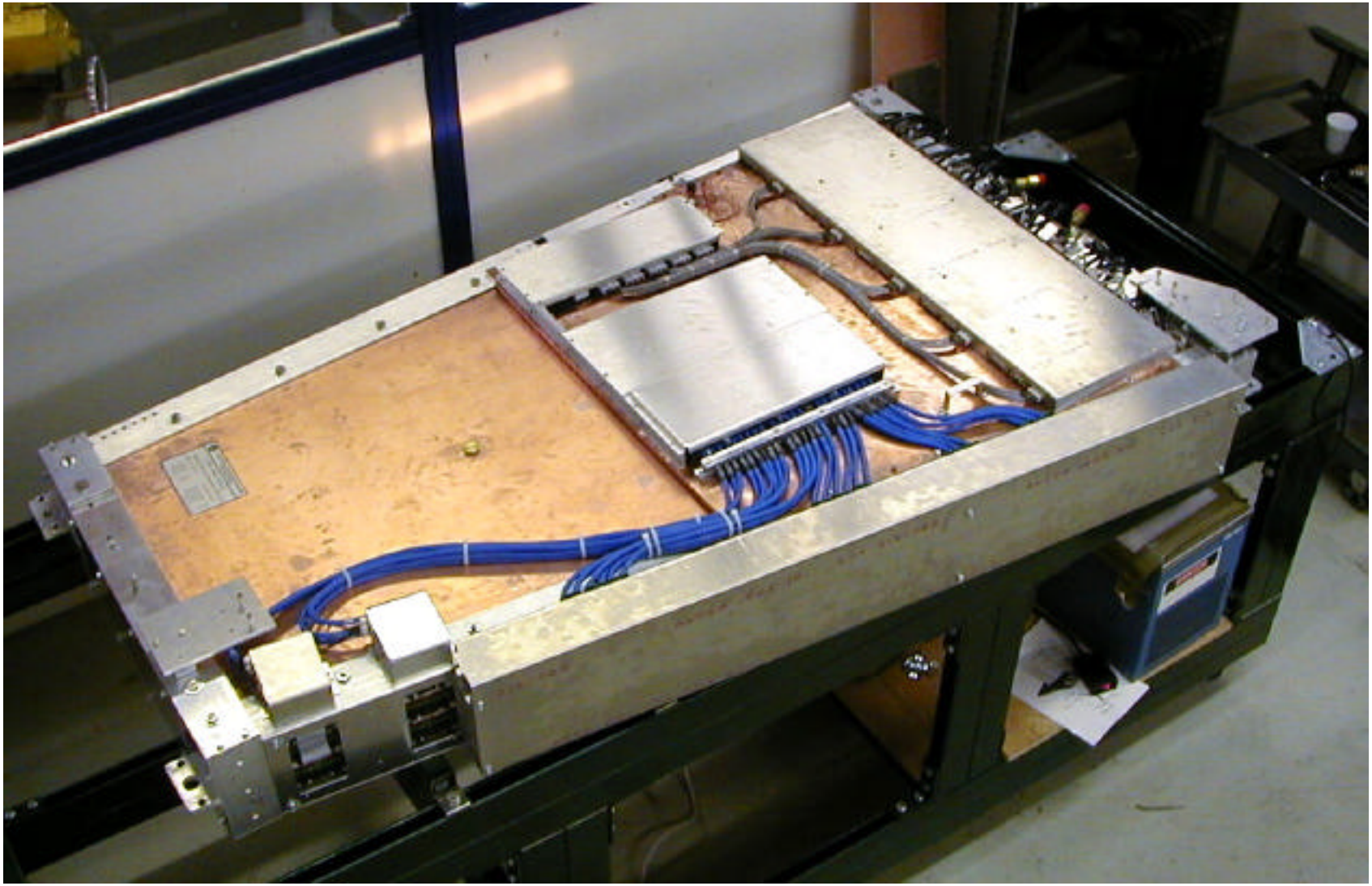
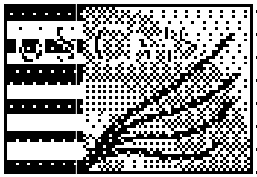
University of Wisconsin

ME 1/2 CSC Prototype





LV System Parameters

396 CSC chambers total

- Includes ME 4/1

CSCs have on-detector electronics

- Cathode FEBs
- Anode FEBs
- ALCT- anode trigger logic
- Low voltage distribution board

Each CSC dissipates slightly more than 100 W

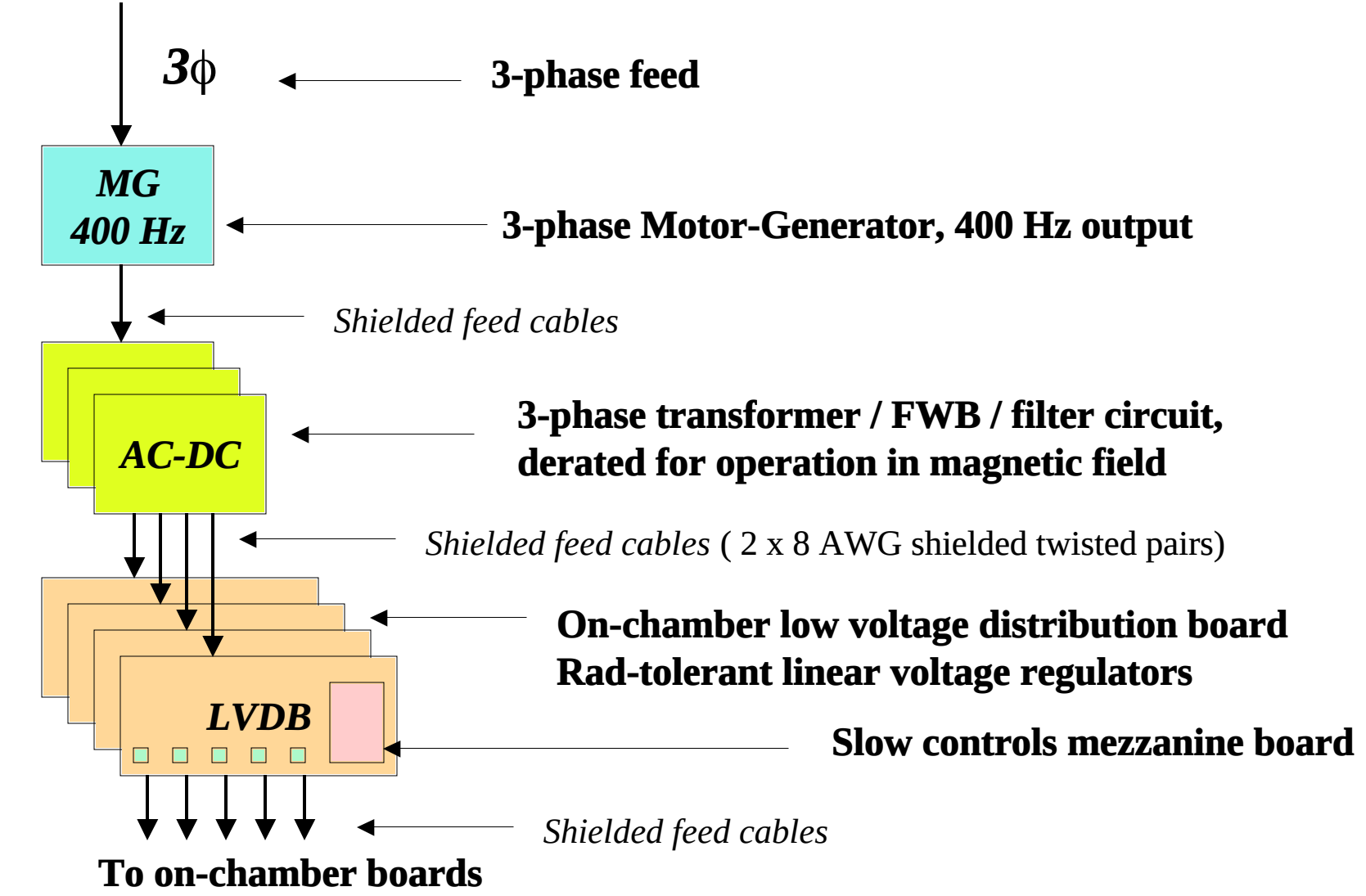
- Heat removed by water-cooled copper plate

Total power required for chambers is 43 kW

Two LV feeds supplied to each chamber

- Digital: 3.7 kA total
- Analog: 2.6 kA total

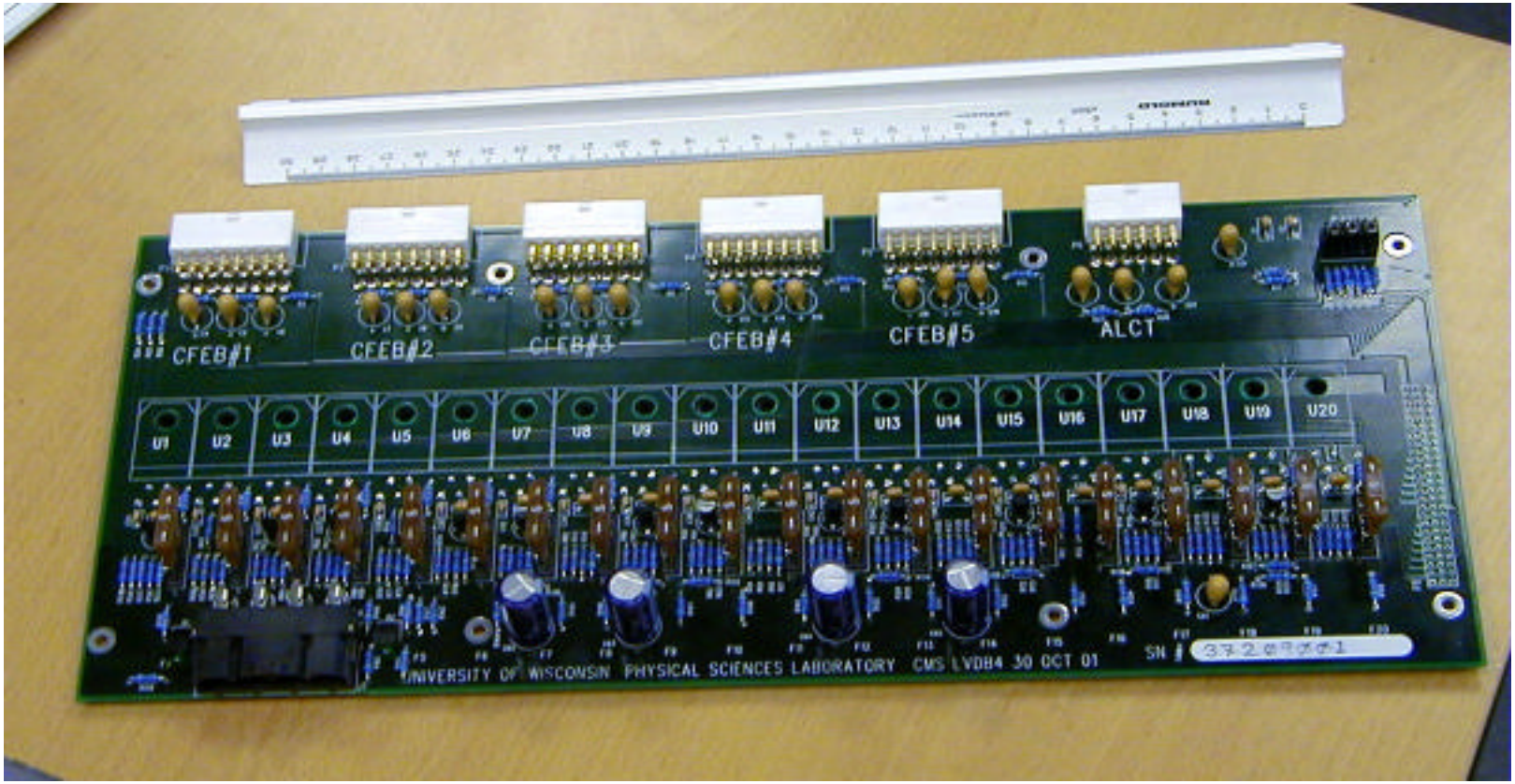
AC-DC LV System Overview



LVDB Status

LVDB design is finalized, fully integrated.

Pilot run of 30 preproduction boards delivered to FAST sites.

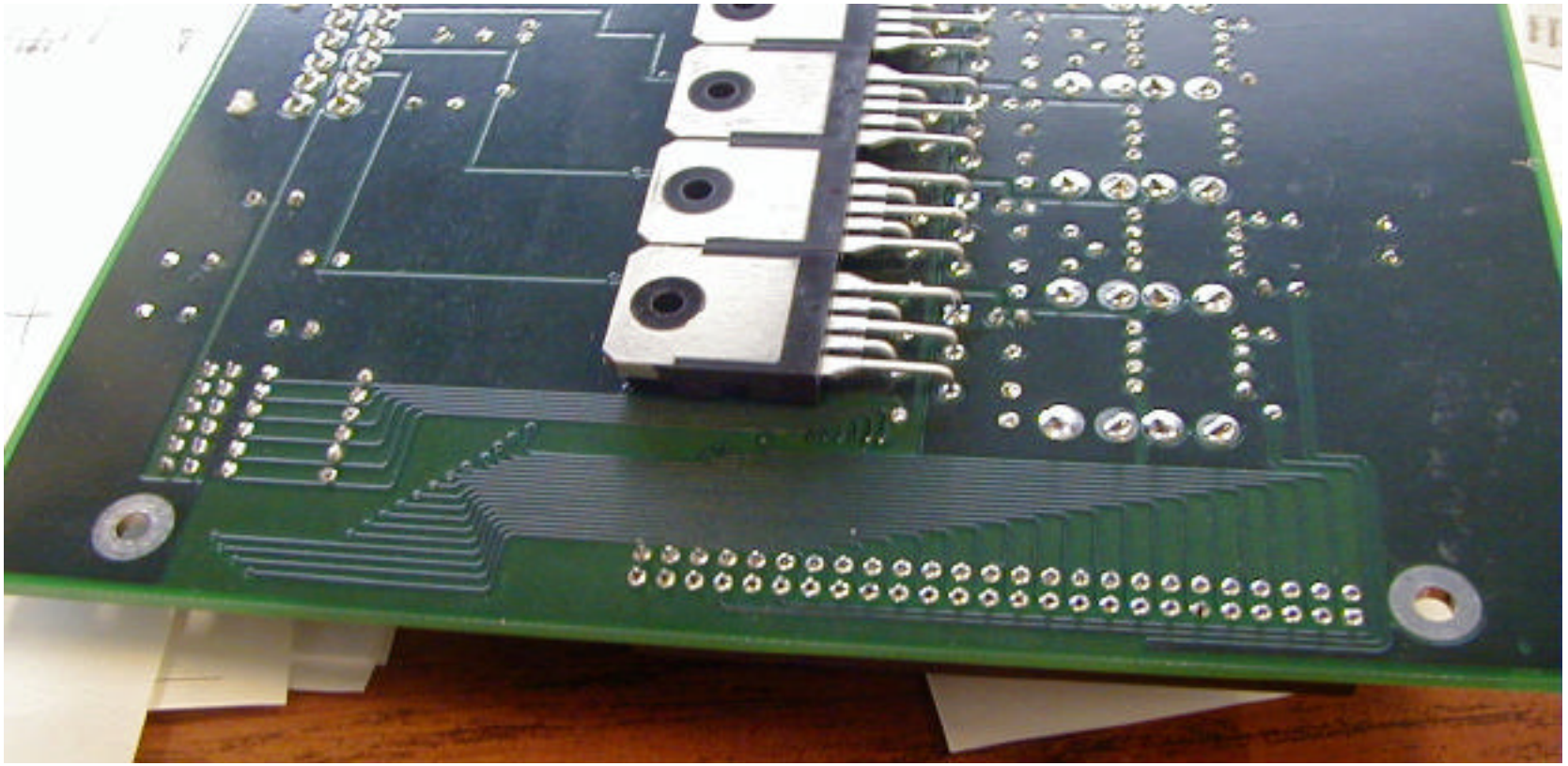


LVDB Production

Parts have been ordered, most have been delivered

PCBs have been delivered

Expect assemblers to begin fabrication over next few weeks

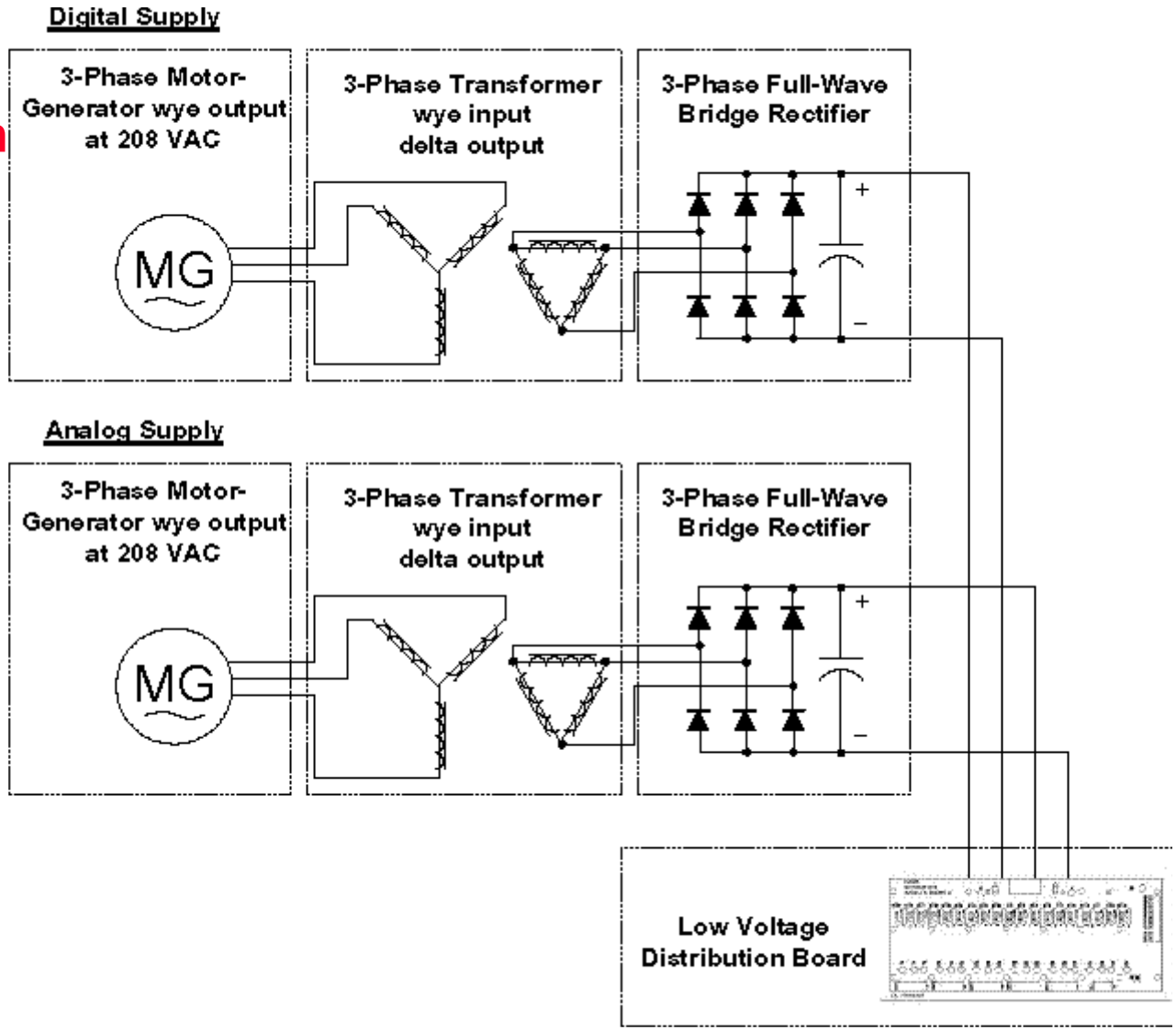


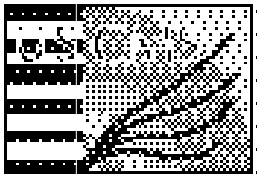
AC-DC P.S. Parameters

- 3-phase, 400 Hz transformers with full-wave rectifiers and filter capacitors mounted on detector
- Supply has no output regulation, will depend on downstream linear regulators on LVDB for regulation, ripple suppression
- Have investigated design using 2 transformers per 60-degree sector, 9 (12) CSCs
- Component cost for LV supply for 60-degree sector is ~$ 1K

AC-DC Supply Overview

- 400 Hz AC would be supplied by motor-generators located in region of low magnetic field.
- Transformers would be mounted on the endcap walkways or in towers.
  - Transformer would be operated in a derated mode
  - May require some magnetic shielding
- Rectifiers and filters would be located at transformer





LV System Status

400 Hz 3-phase AC-DC prototype design

- Built and tested at PSL
- Supplies 7.5 V at 100 amps

AC-DC system magnetic field simulations

- POISSON for 2-D simulation
- OPERA for 3-D (V. Klioukhine)

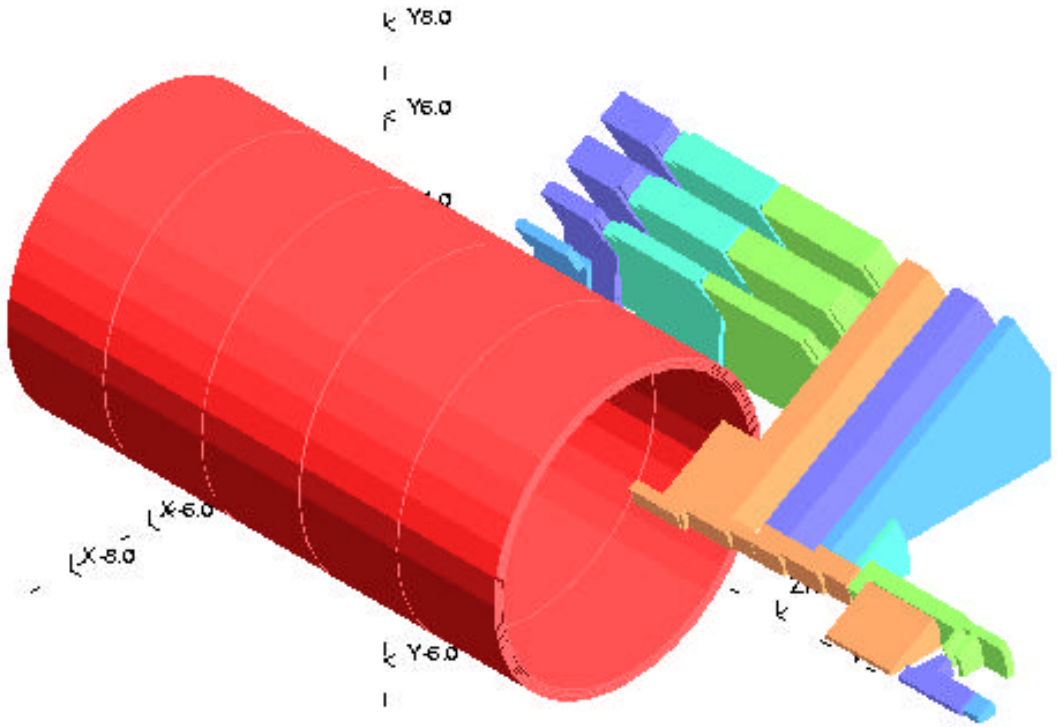
Magnetic field tests at CERN

- First round 11 Feb. 02
  - Objective was to determine if transformer operation in an ambient field of 1.2 kG is possible for prototype 3-phase transformer
- Second round of tests 12 Mar. 02

Constructed complete power supply

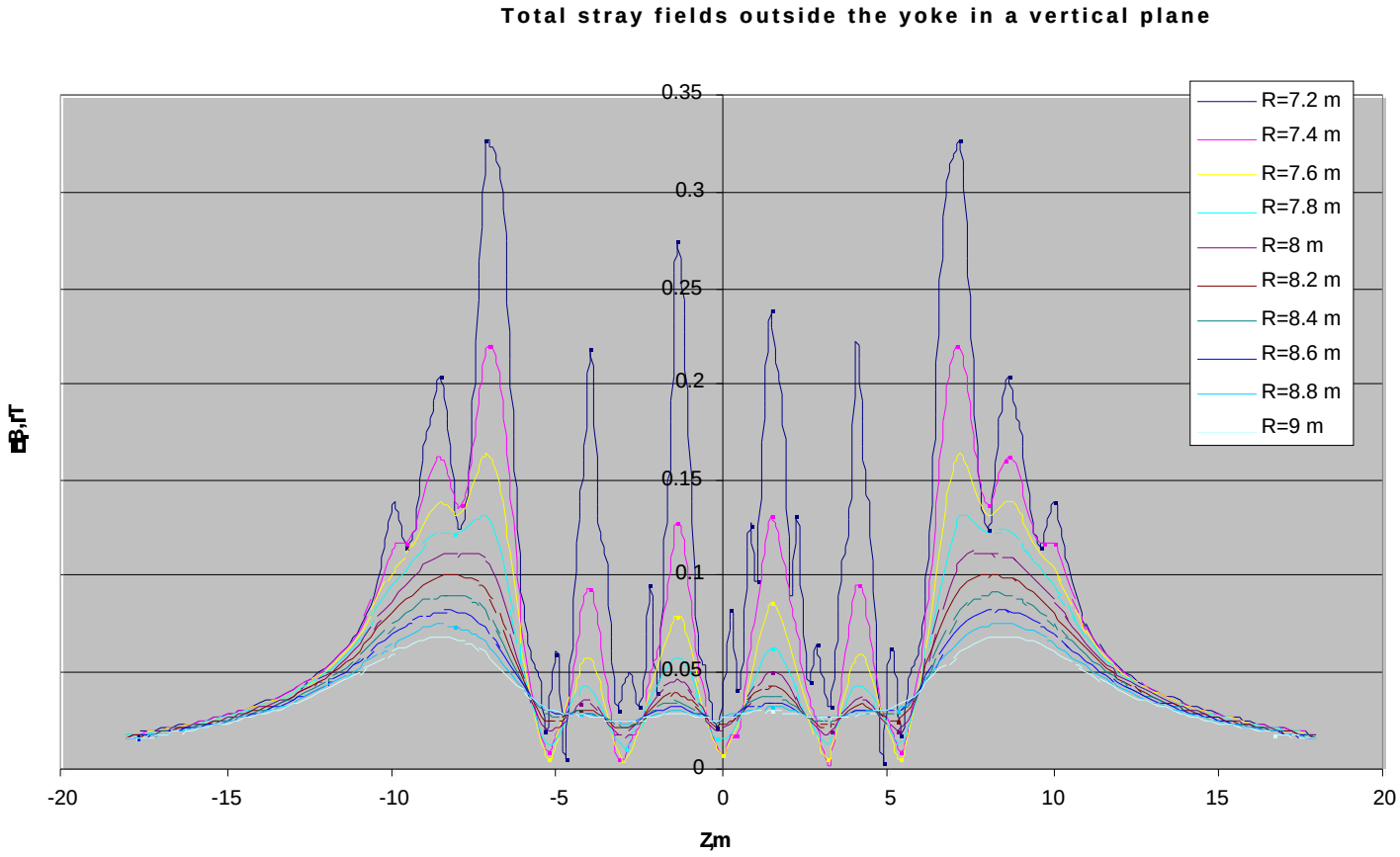
- Dual transformers, water cooled, industrial enclosure
- Being shipped to CERN

TOSCA Model Description



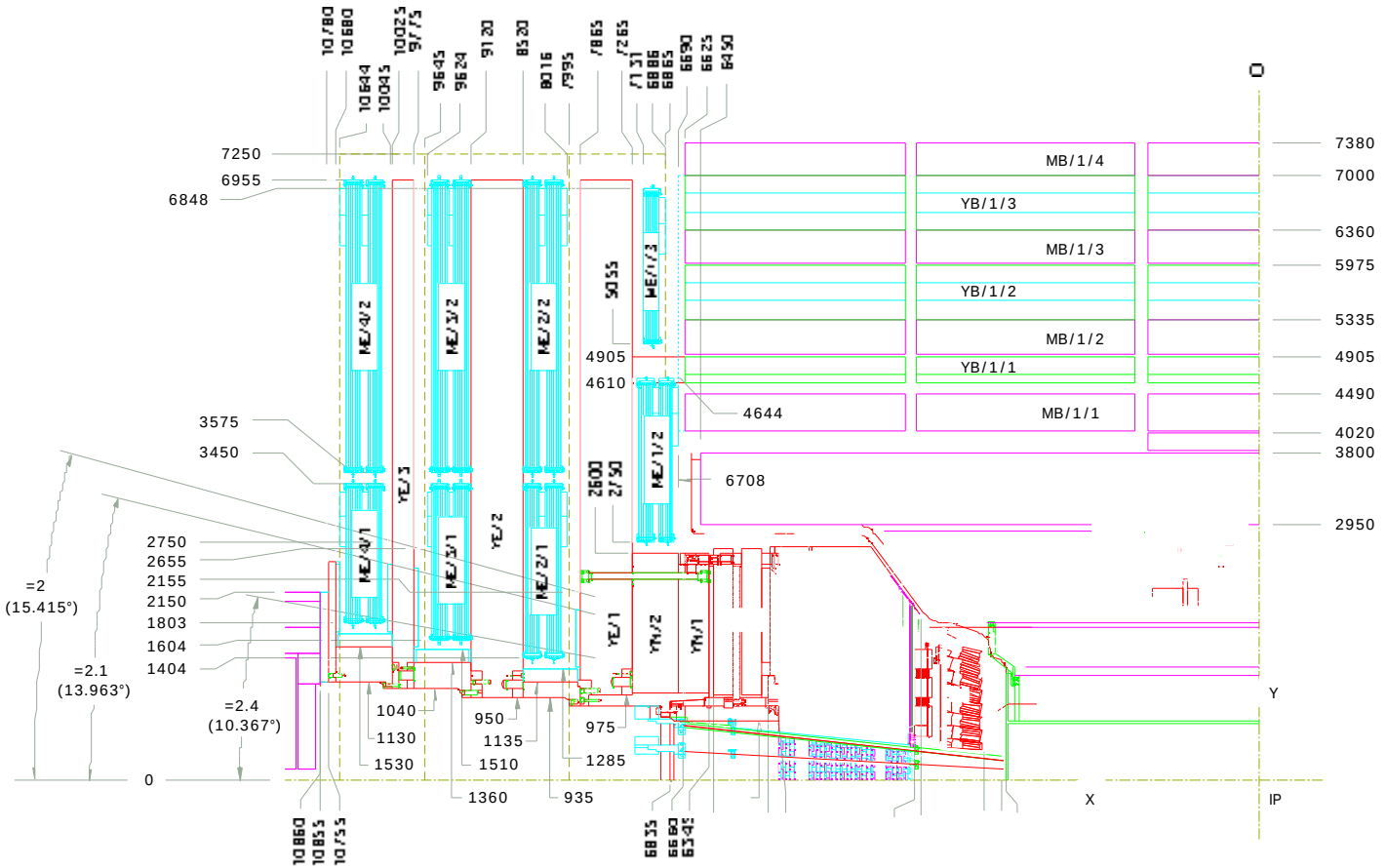
From V. Klioukhine

Total Stray Fields Outside the Yoke



From V. Klioukhine

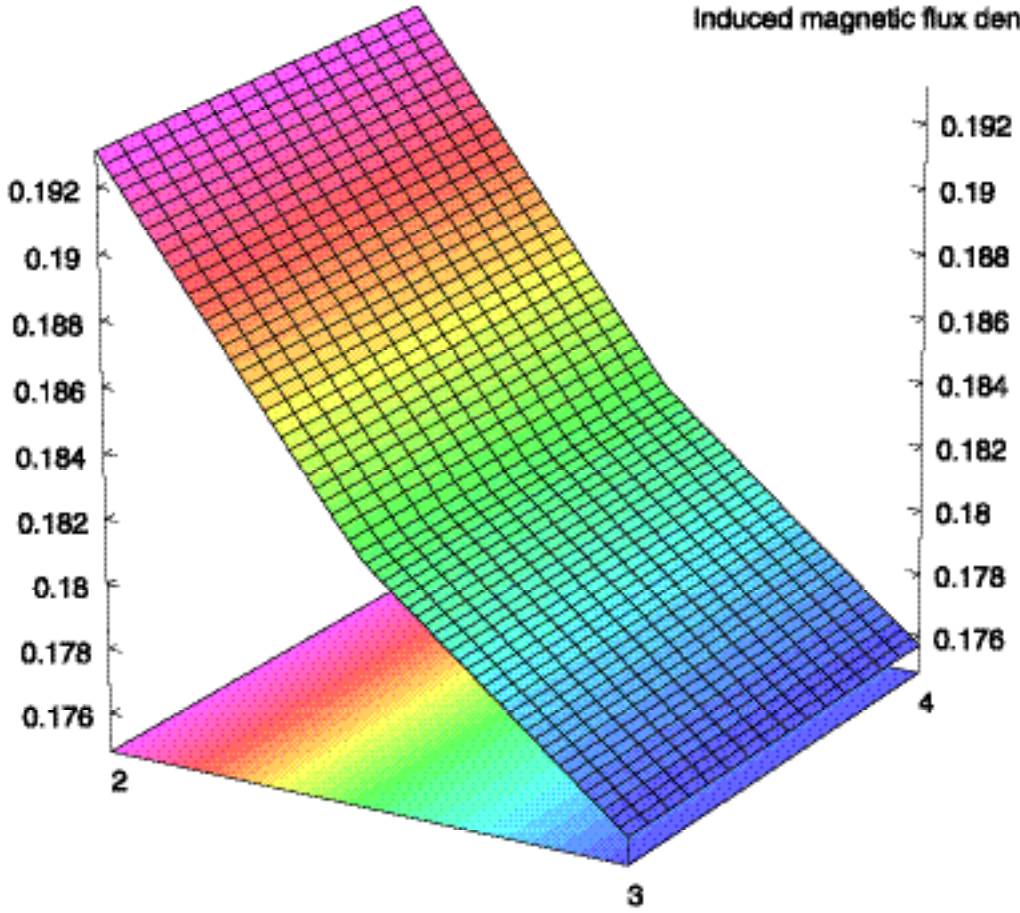
One-quadrant cross-section



Largest fringe field will be over YE1 region

JDP 12-7-99
CMS 5185_090

Magnetic FEA Results

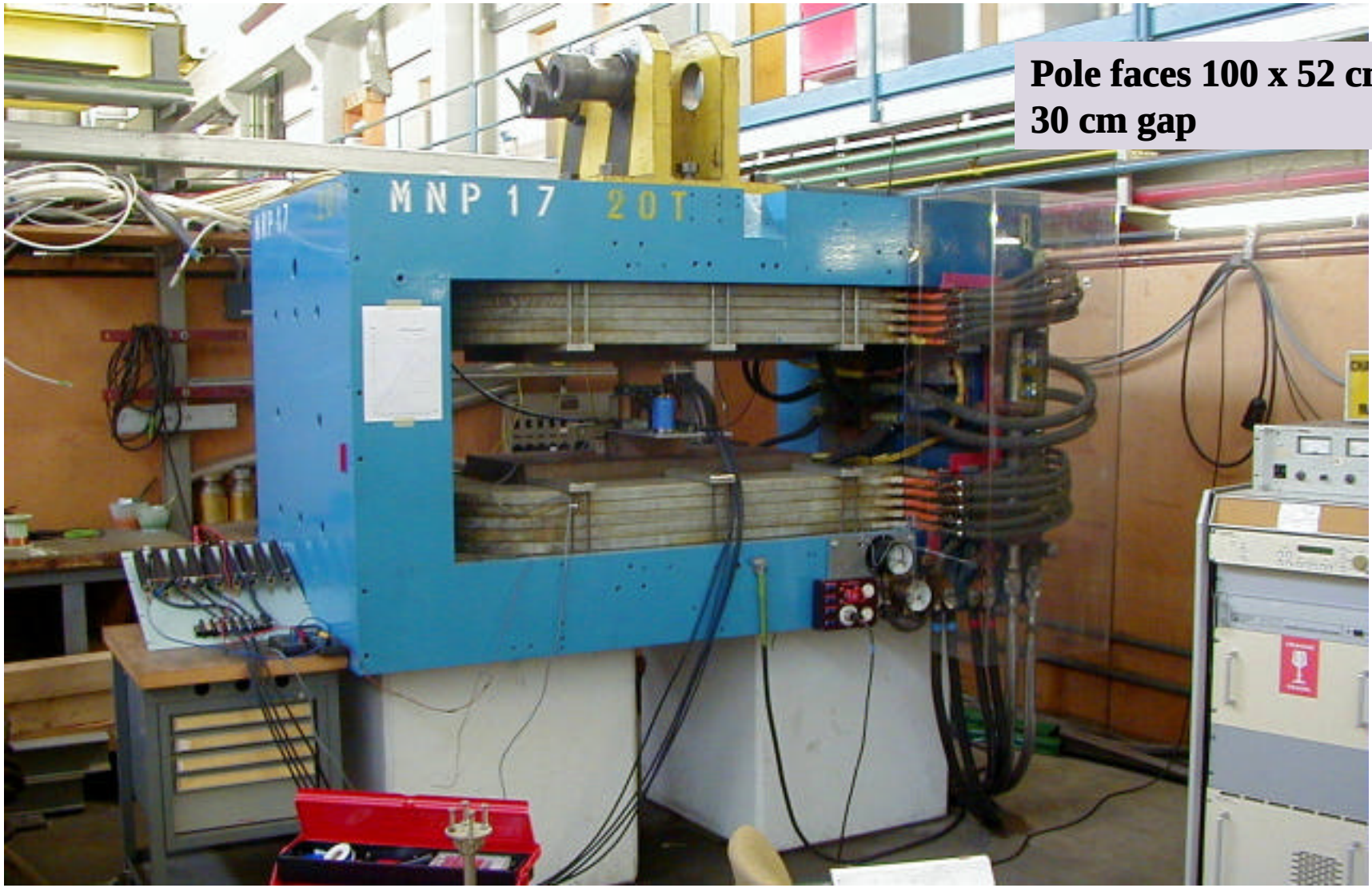


Transformer in central vertical plane, over YE1 at Y=7.5m

Winding axes are vertical

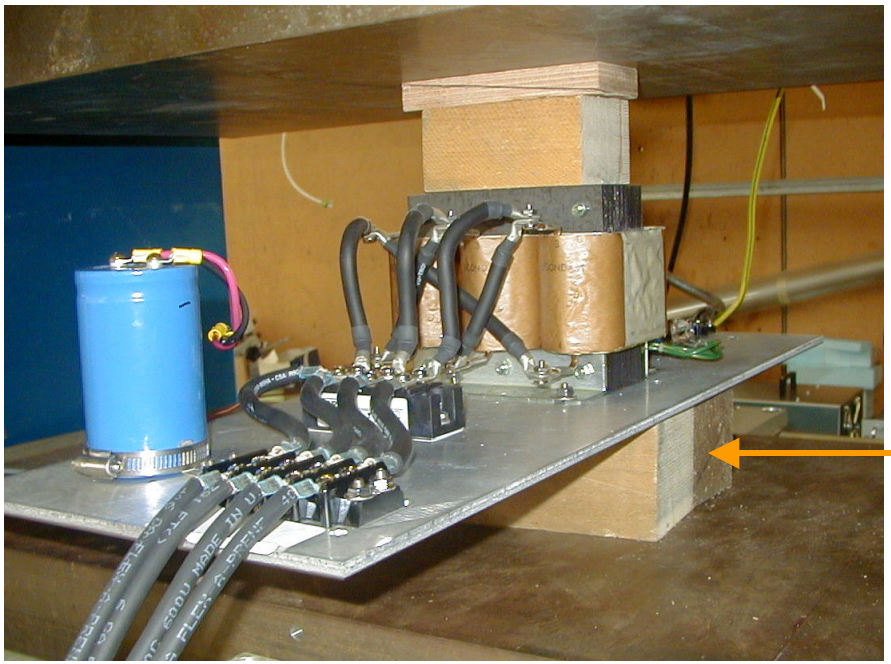
Max. Field is ~10% of full saturation value

Test Magnet



Pole faces 100 x 52 cm, 30 cm gap

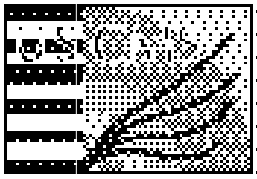
Transformer test setup



Transformer in magnet, core ~7cm away from each pole face to prevent magnet iron from acting as part of transformer magnetic circuit

Gaussmeter probe location

0.1 Ohm load, 5 kW

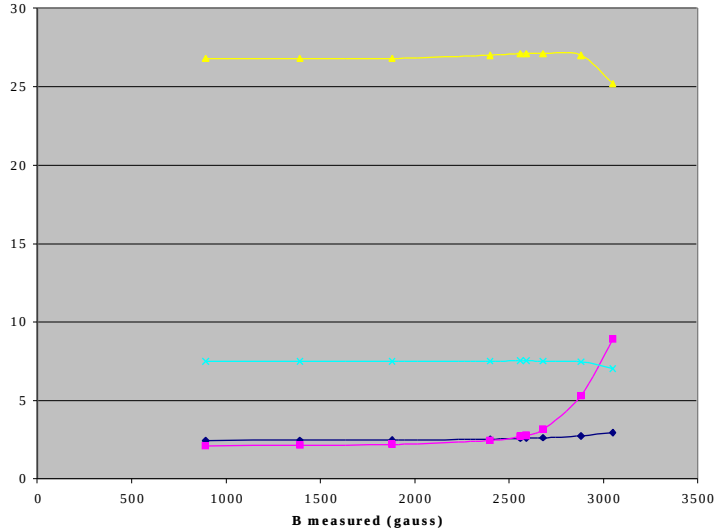


Magnetic Field Test Results

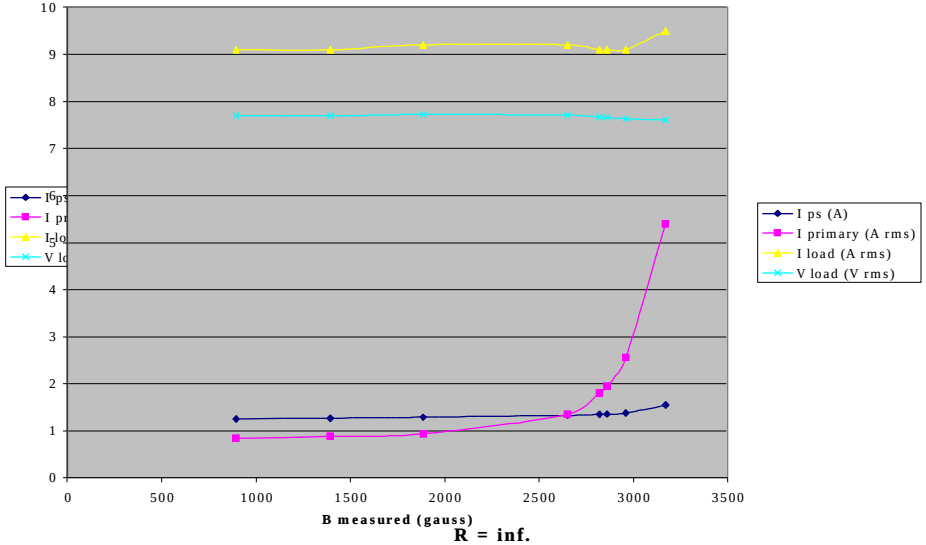
Magnet current	B nominal	B local	Load voltage	Primary current
32.5 A	0.50 kG	0.93 kG	7.26 V	14.0 A (p-p)
49.9	0.75	1.39	7.27	15.0
66.6	1.25	2.51	7.26	15.0
88.7	1.30	2.66	7.27	15.5
89.8	1.35	2.68	7.26	15.5
93.1	1.40	2.78	7.20	17.0
99.8	1.50	2.97	6.93	24.2
106.4	1.60	3.16	6.18	34.0

Testing AC Characteristics

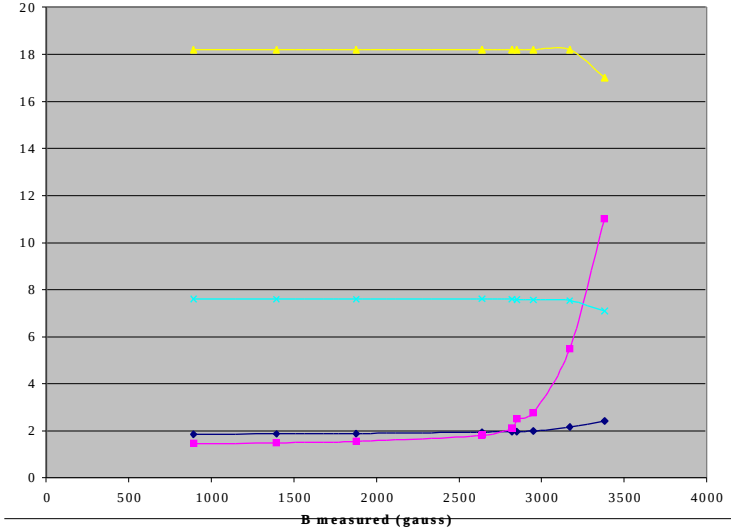
R = 0.166 ohm



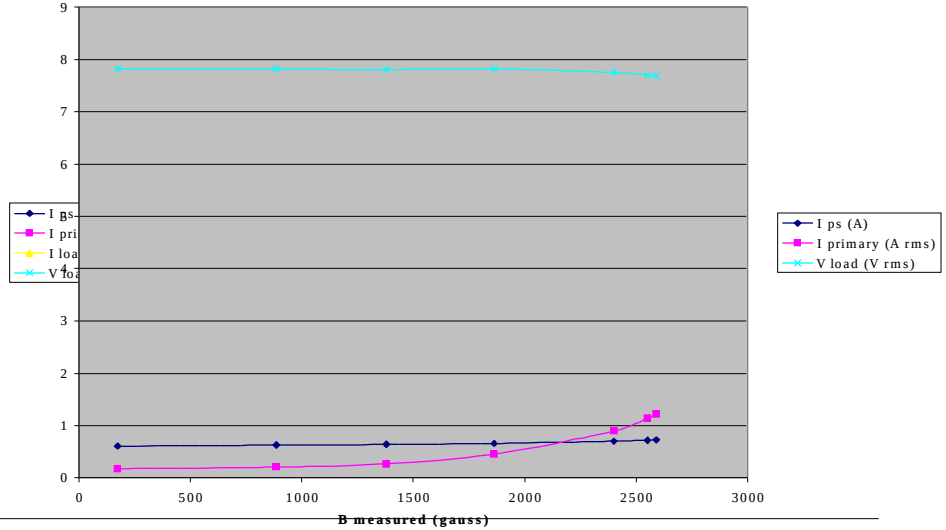
R= 0.5 ohm



R = 0.25 ohm

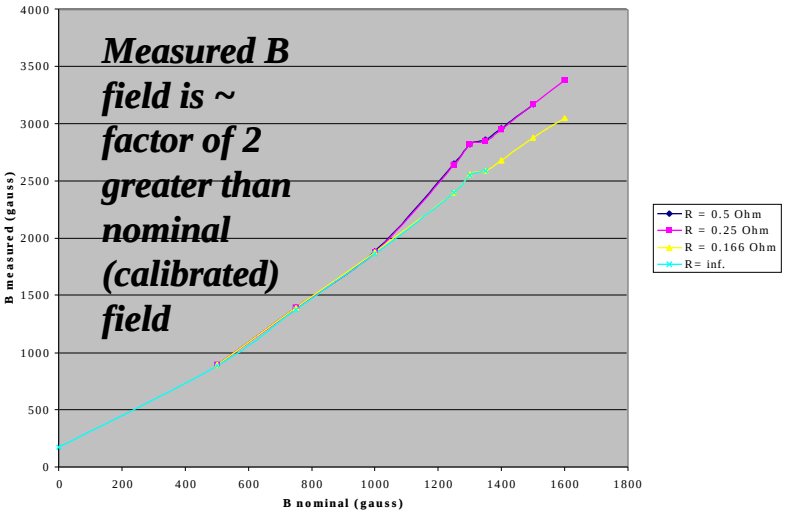


R = inf.



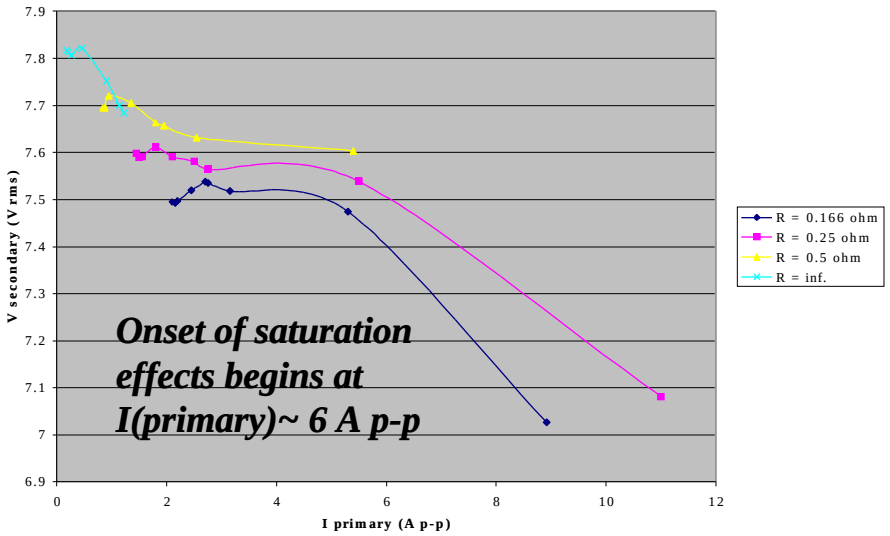
Mag. Test Summary

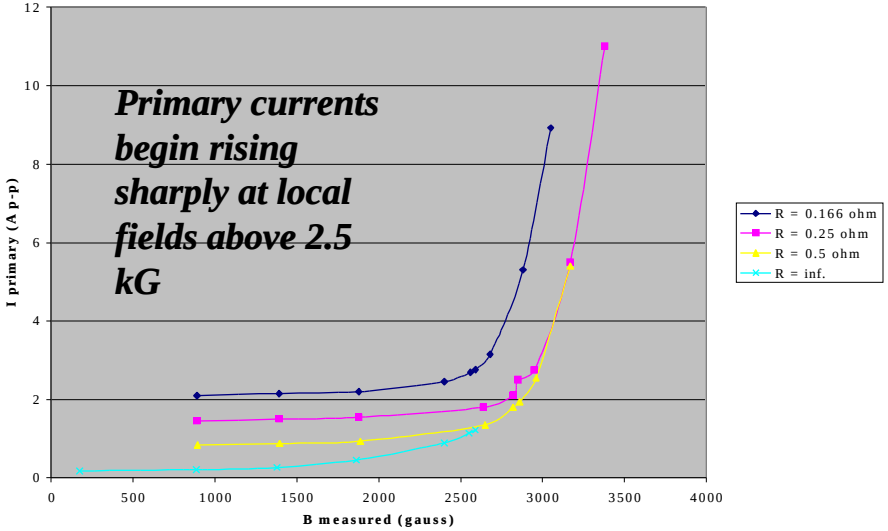
B field at transformer



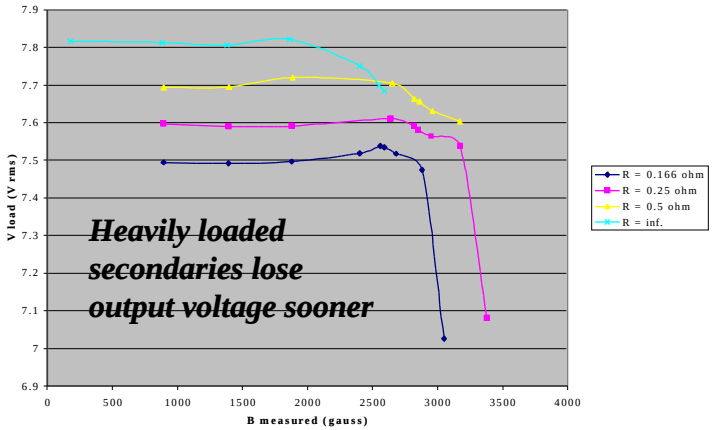
I primary vs. B Measured

V sec. vs. I prim.



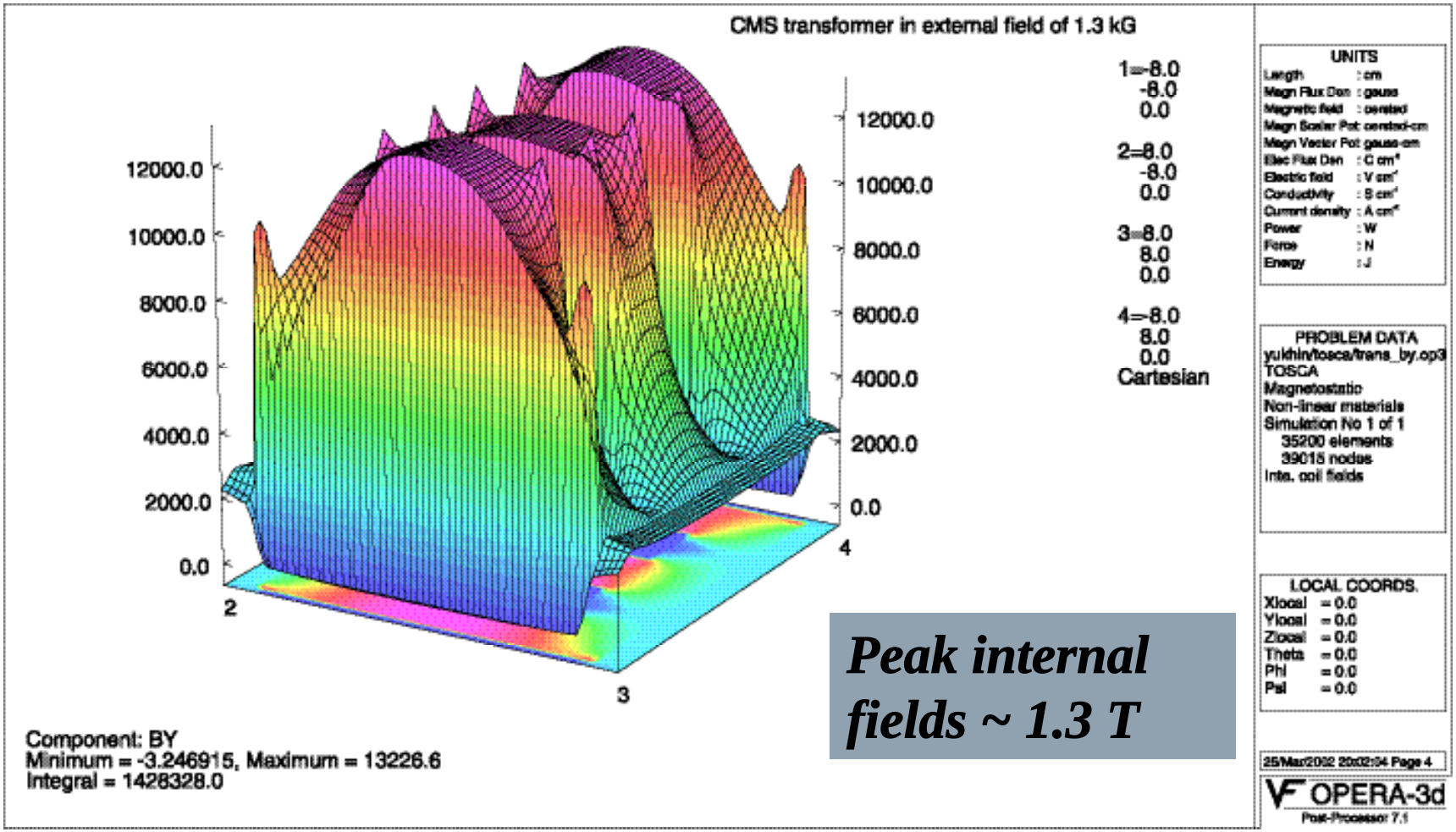


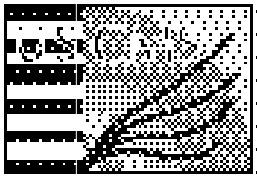
V secondary vs. B measured



Magnetic FEA for 1.3 kG

Field directed along axis of windings:





Mag Field Test: Conclusions

Results of magnetic field tests of AC-DC converter demonstrate that operation of transformer-based LV system in an ambient field of 1.3 kG is possible

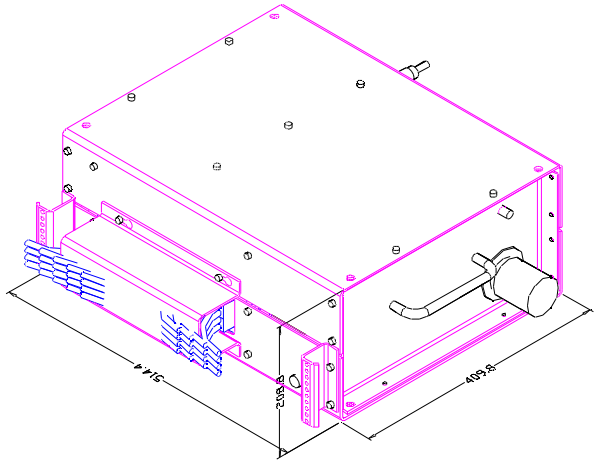
- **May be able to optimize transformer core design to operate directly on disk periphery without additional magnetic shielding**
- **Should be able to take advantage of transformer orientation to increase magnetic field tolerance**

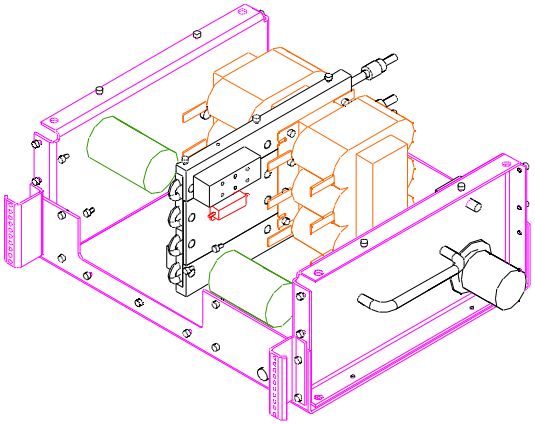
In principle, the prototype 3-phase transformer we tested could be used as is for the EMU low voltage system

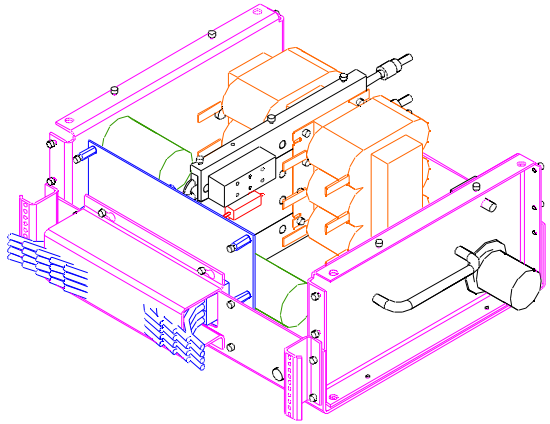
Currently building prototype LV supply box to model entire LV supply

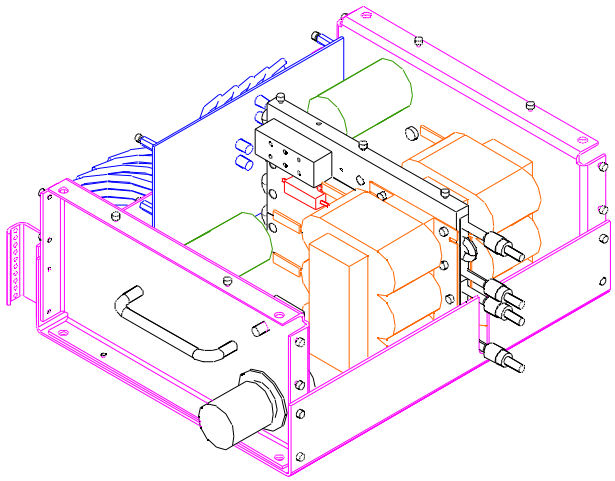
LV Power supply

Prototype enclosure design







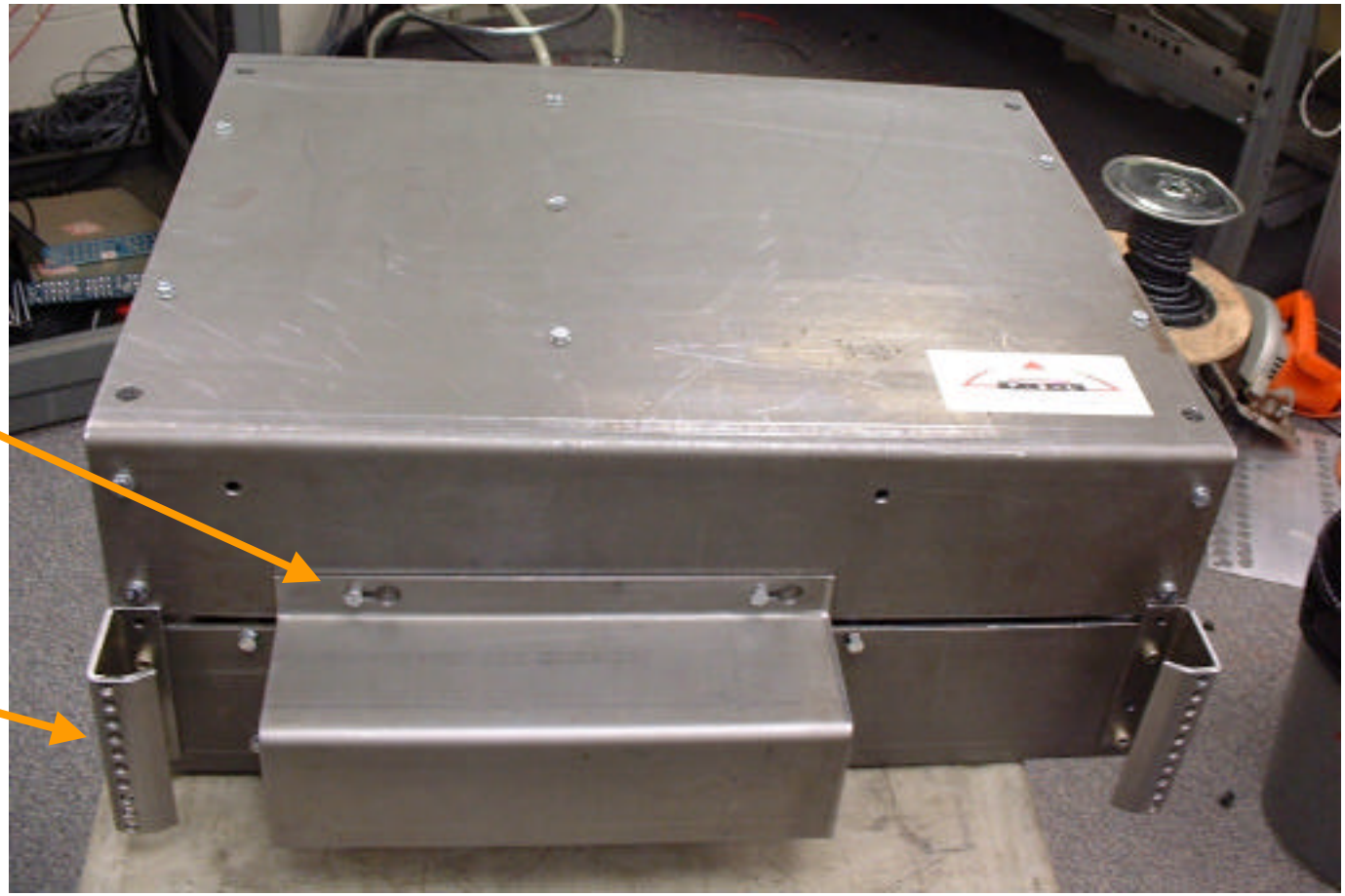


LV Power Supply, front

Shows clamshell construction, cable shield, strain reliefs.

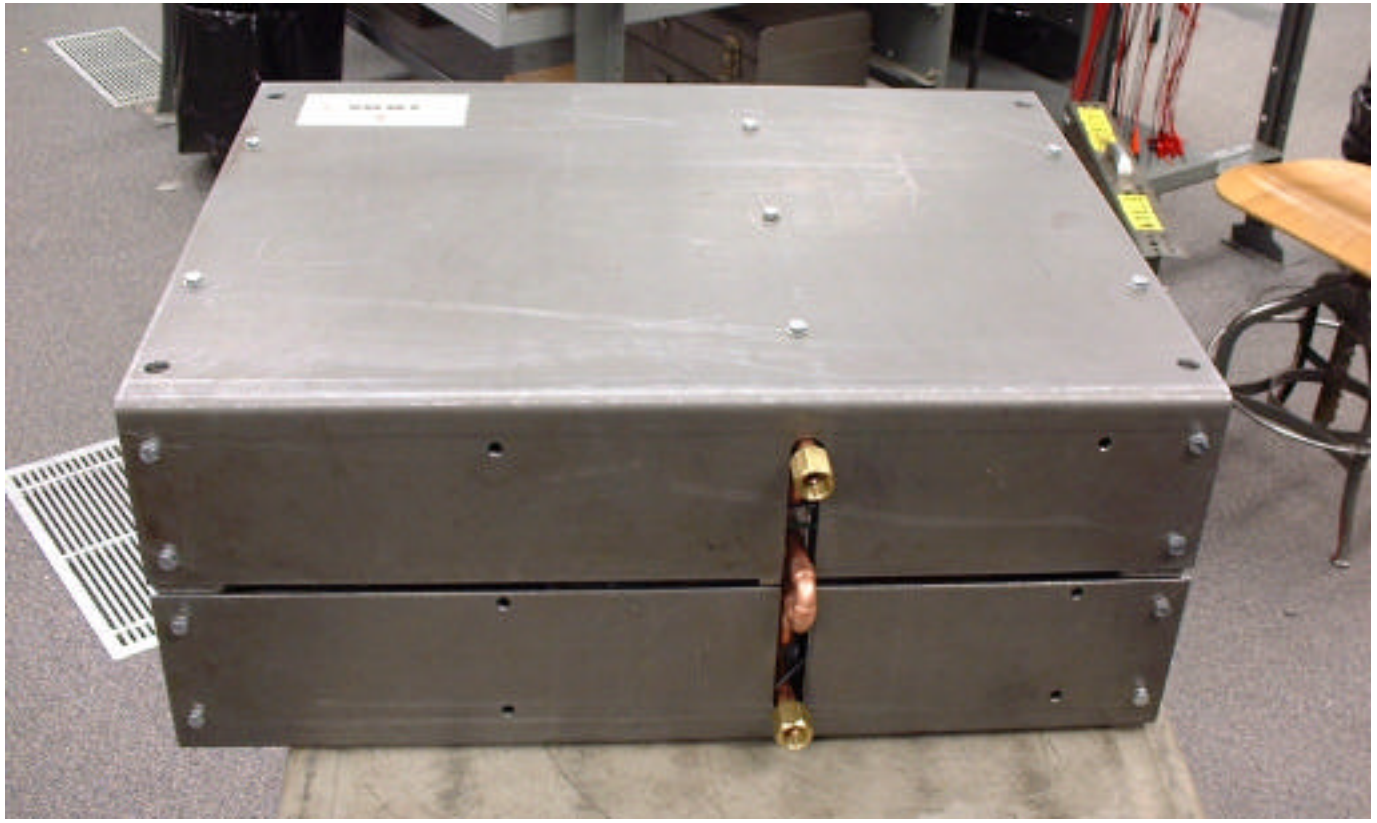
Keyhole screw mounts

Strain reliefs

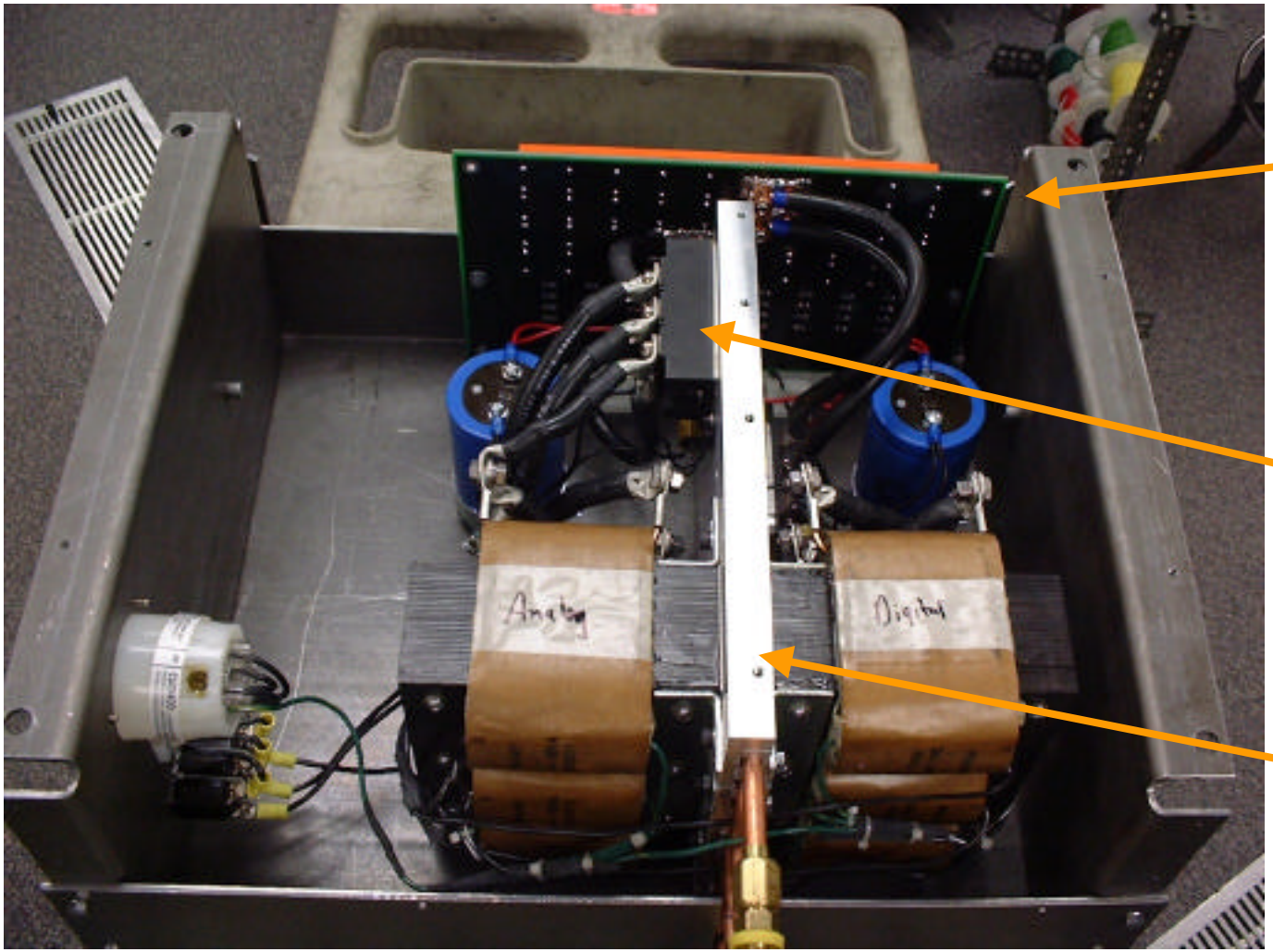


LV Power Supply, rear view

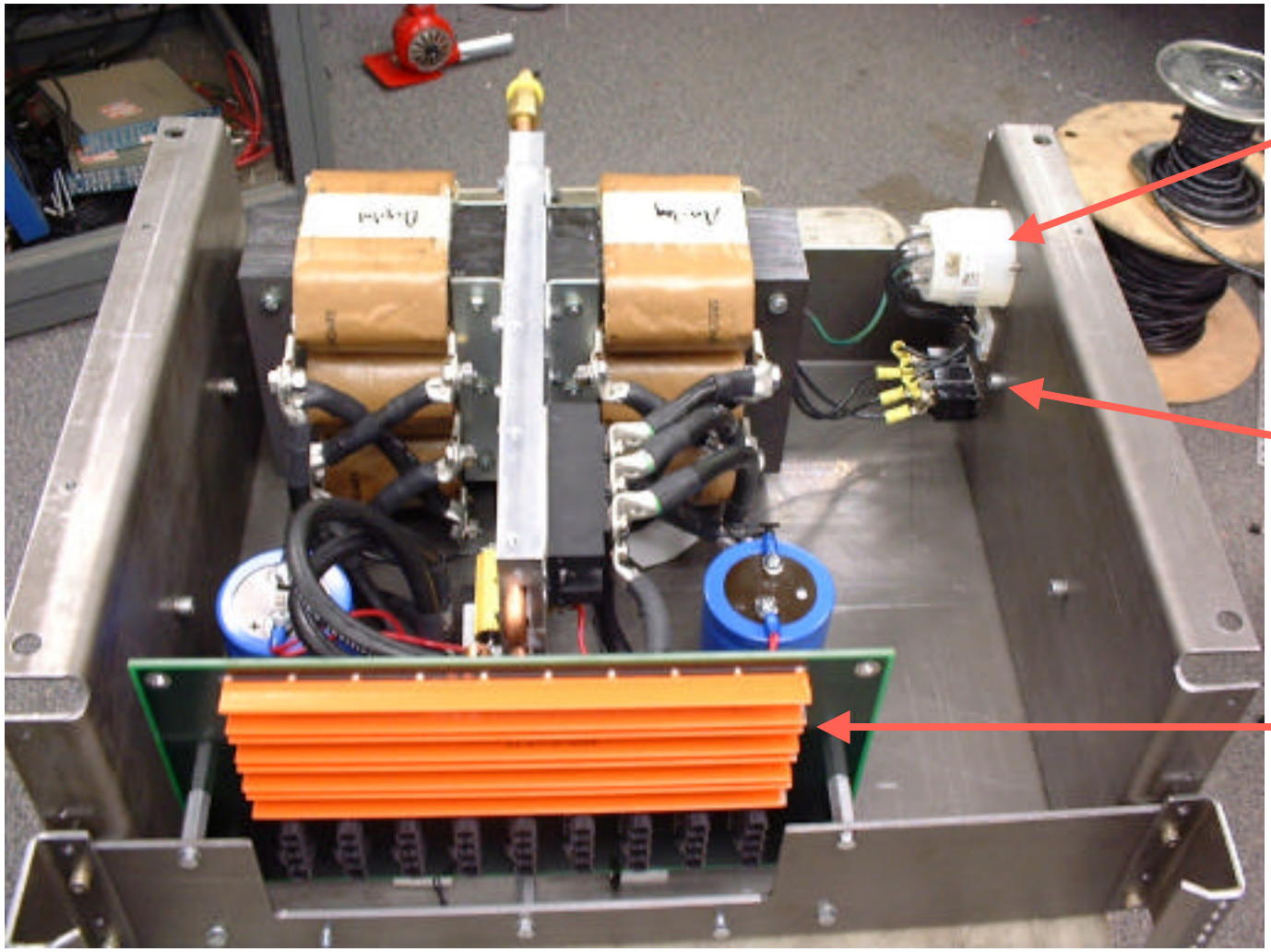
Shows cooling connections, uses flare fitting to hose-barb union (not shown)



LV Power Supply, plan view



Connector board …

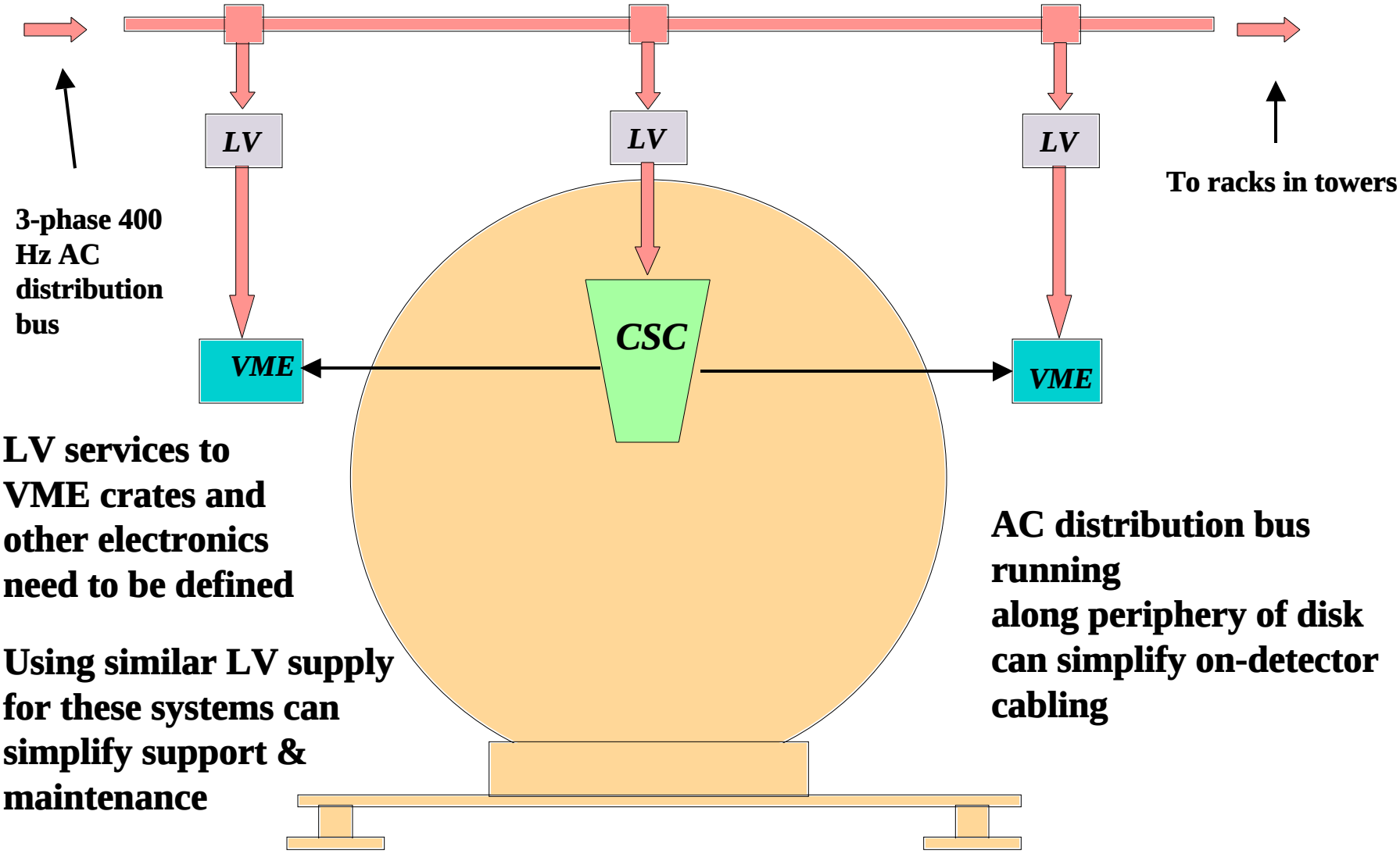


3-phase, 4-wire input connector

Thermal circuit breaker

Distribution bus bars

Low Voltage Services



LV services to VME crates and other electronics need to be defined

Using similar LV supply for these systems can simplify support & maintenance

AC distribution bus running along periphery of disk can simplify on-detector cabling